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# Genetic variability, heritability and genetic advance in tomato [*Solanum lycopersicon* (Mill.) Wettsd]

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**ABSTRACT :** Genetic variability is the backbone of plant breeding on which selection acts to evolve superior genotypes. In this context, ten lines with four testers were crossed in a line × tester mating design to estimate the variability, heritability and genetic advance for yield and its component traits in tomato. Analysis of variance revealed significant differences for all the traits studied. The estimates of GCV, PCV, heritability (broad sense) along with high genetic advance was observed for number of fruits per plant, early yield per plant and total yield per plant indicating thereby presence of large amount of variability and additive gene action for expression of these traits. Hence, selection for these traits will be effective however, for other traits hybridization followed by selecting desirable transgressive segregants will be better options for genetic improvement of tomato.

**KEY WORDS :** GCV, Genetic advance, Heritability, PCV, Tomato

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Tomato [*Solanum lycopersicon* (Mill.)Wettsd.] is one of the most important vegetable crops grown throughout the world not only as a good sources of nutrition to the consumers but also for its higher returns to small and marginal farmers. Tomato a member of family Solanaceae, is an herbaceous, annual, prostrate and sexually propagated vegetable having an identical genomic formula 2n = 2x = 24. It has tap root with bisexual hypogenous flowers. The growth habit of the plant is determinate or indeterminate. Scientific information indicates that cultivated tomato probably originated in the Peru-Ecuador region (Kalloo *et al*., 2001). It is used as fresh as well as processed vegetable. It is also very important for processing industry as it ranks first as processing vegetable crops in the world. Ripe tomato is widely used for the preparation of several processed items *i.e.*, paste, puree, syrup, juice, soup, ketchup, drinks, whole peeled tomato and canned tomato etc, in the processing industry on a large scale. Being a very good appetizer, tomato is also a rich source of minerals, vitamins and organic acids.

Among the several mating designs adopted for the study of genetic architecture in tomato, line x tester mating design has been widely used for evaluation of more number of genotypes at a time for combining ability effects (Kempthorne, 1957). Several workers have successfully utilized the line x tester analysis for obtaining the gene effects and identifying superior donors for various traits in tomato (Kumar *et al*., 1997; Srivastava *et al*., 1998 and Dhaliwal *et al*., 2000). Hence, in present investigation an attempt was made to assess the indicatives of variability *i.e*. genotypic co-efficient of variation (GCV) and phenotypic co-efficient of variation (PCV), heritability in broad sense ($h^2$bs), genetic advance

(GA) and genetic advance as per cent of mean (GG).

## RESEARCH METHODS

Ten homozygous and genetically diverse lines *viz*., NDS-95-43, NDT-2002-1, NDT-8, NDT-3, NDT-15, NDT-73, NDT-11, NDT-34, NDT-44-1 and NDT-74 and 4 tester's *viz*., NDT-2, H-24, NDT-6 and NDT-21 were chosen for building up the experimental material.Tomato varieties/ genotypes differing in growth habit (determinate or indeterminate) and fruit shape and size, were selected as parents from the genetic stock material in Department of Vegetable Science, N.D. University of Agriculture and Technology, Kumarganj, Faizabad. These strains were crossed in line x tester mating fashion during *Rabi* crop season 2012-13 and evaluated in Randomized Block Design during *Rabi* crop season 2013-14. The experimental material comprised of 40 $F_1$'s' and 14 parents (10 lines + 4 testers). All the 54 genotypes including $F_1$ progenies were planted in October 2013-14 in Randomized Block Design with 3 replications during Oct 2013. Each parent and $F_1$ 's' were planted in one row of 4.5 meter long which contains 10 seedlings of each $F_1$ 's' and parental lines in each replication. Thirty days old seedlings were transplanted at the spacing of 60 cm apart and 45 cm between plants. All the recommend agronomical practices and plant protection measures were followed to raise a good crop. Observations were recorded on five randomly selected plants for 12 quantitative characters *viz*., plant height(cm), number of primary branches/plant, length of fruit (cm), diameter of fruits (cm), thickness of pericarp (cm), total soluble solid (%), ascorbic acid content (mg/ 100g), titrable acidity (%), number of fruits/plant, average weight of fruit (g), early yield per plant (kg) and total yield per plant (kg). PCV and GCV were calculated by the formula given by Burton (1952), heritability in broad sense ($h^2$) by Burton and De Vane (1953) and Hanson *et al*. (1956). Genetic advance *i.e*. the expected genetic gain was calculated by using the procedure given by Johnson *et al*. (1955).

## RESEARCH FINDINGS AND DISCUSSION

The analysis of variance (Table 1) revealed significant differences among the genotypes for all the characters studied, indicating presence of sufficient genetic variability among the genotypes for all the traits. The presence of large amount of variability might be due to diverse source of materials taken as well as environmental influence affecting the phenotypes. Similar findings were also reported by Ali *et al*. (2008); Ajmal *et al.* (2009) and Gulnaz *et al.* (2011).

The character possessing high genotypic co-efficients of variation value have better scope of improvement through selection. The influence of environment on each trait could be determined on the basis of difference between phenotypic co-efficient of variation and genotypic co-efficient of variation. The estimates of PCV were higher than GCV for all the traits (Table 2). However, relatively low magnitude of difference was observed between GCV and PCV indicating less environmental influence. The high PCV

**Table 1: Analysis of variance for 12 characters in tomato**

| Sr. No. | Characters d.f. | Source of variation | | |
|---|---|---|---|---|
| | | Replication | Treatments | Error |
| | | 2 | 53 | 106 |
| 1. | Plant height(cm) | 48.76** | 429.86** | 21.68 |
| 2. | Number of primary branches/plant | 0.127 | 1.70** | 0.13 |
| 3. | Length of fruit (cm) | 0.03 | 8.42** | 0.07 |
| 4. | Diameter of fruits (cm) | 0.07 | 3.11** | 0.08 |
| 5. | Thickness of pericarp (cm) | 0.003 | 10.86** | 0.0009 |
| 6. | Total soluble solid (%) | 0.20 | 10.49** | 0.06 |
| 7. | Ascorbic acid content (mg/100g) | 14.81 | 50.70** | 11.08 |
| 8. | Titrable acidity (%) | 0.006 | 4.04** | 0.002 |
| 9. | Number of fruits/plant | 7.29 | 338.58** | 5.20 |
| 10. | Average weight of fruit (g) | 12.99 | 136.06** | 5.10 |
| 11. | Early yield per plant (kg) | 0.005 | 1.51** | 0.003 |
| 12. | Total yield per plant (kg) | 0.03 | 6.79** | 0.02 |

* and ** indicate significance of values at P=0.05 and 0.01, respectively

was recorded for plant height, ascorbic acid content, titrable acidity, number of fruits/plant, early yield/plant, total yield per plant. Moderate PCV were estimated for number of primary branches/ plant, length of fruits, thickness of pericarp, total soluble solid and average weight of fruit. The high GCV were recorded for plant height, number of fruits/plant, early yield per plant and total yield per plant while as moderate GCV were recorded for number of primary branches/plant, length of fruit, thickness of pericarp, total soluble solids, ascorbic acid content, titrable acidity and average weight of fruit. The similar result was earlier reported by Chandrasekhar and Rao (1989).

These values alone are not helpful in determining the heritable portion of variation (Falconer, 1960). The proportion of genetic variability which is transmitted from parents to offspring is reflected by heritability (Lush, 1949). In this context, the high estimates of heritability was recorded for plant height, number of primary branches/plant, length of fruit, thickness of pericarp, total soluble solid, titrable acidity, number of fruits/plant, average weight of fruit, early yield per plant and total yield/plant. Moderate heritability were recorded for diameter of fruits and ascorbic acid content. The characters with exhibited high heritability, suggested that the selection will be more effective. According to Panse (1958) such characters are governed predominantly by additive gene action and could be improved through individual plant selection. Whereas, low heritability indicated that the characters were highly influenced by environmental effect and genetic improvement through selection will be difficult due to effect of non-additive genes.

Johnson *et al.* (1955) have showed that a character exhibiting high heritability may not necessarily give high genetic advance. High genetic advance as per cent of mean were obtained for number of fruits, early and total yield/plant, while moderate was for plant height, number of primary branches/plant, length of fruit, thickness of pericarp, total soluble solid, titrable acidity and average weight of fruit, while as low genetic advance were found for diameter of fruits and ascorbic acid content. These finding were supported with the finding of Ali *et al.* (2008).

It is better when heritability in conjunction with genetic advance is studied (Dudley and Moll, 1969). Thus, a character possessing high heritability along with high genetic advance will be valuable in the selection programme. The estimates of heritability coupled with genetic advance are more useful selection parameter than heritability alone. High heritability coupled with high genetic advance was noted for plant height and number of fruits/plant, early yield/plant and total yield/plant. Hence, selection for these traits will be effective in improvement of tomato as these traits. This indicated that there is predominant role of additive gene action for these traits and hence, selection for these traits will be effective in improvement of tomato. Such finding was also reported by Ajmal *et al.* (2009) and Gulnaz *et al.* (2011).

**Table 2 : Mean, range, co-efficient of variation, heritability and genetic advance for 12 characters in tomato**

| Characters | General mean ± S.E. | Range | | PCV | GCV | $h^2$ (bs) | GA | GG |
|---|---|---|---|---|---|---|---|---|
| | | Parents | Crosses | | | | | |
| Plant height (cm) | 77.5±21.68 | 51.53-100.53 | 64.20-108.83 | 16.34 | 15.2 | 86.57 | 29.15 | 37.34 |
| Number of Primary branches/plant | 5.70±0.13 | 3.80-6.83 | 4.27-7.00 | 14.22 | 12.68 | 79.55 | 1.71 | 29.86 |
| Length of fruit (cm) | 4.57±0.07 | 3.59-5.45 | 4.06-5.69 | 12.6 | 11.2 | 79.03 | 1.2 | 26.29 |
| Diameter of fruits (cm) | 4.98±0.08 | 4.12-5.17 | 4.29-5.50 | 8.27 | 6.08 | 54.03 | 0.58 | 11.8 |
| Thickness of Pericarp (cm) | 0.51±0.009 | 0.27-0.59 | 0.46-0.59 | 12.79 | 11.3 | 78.05 | 0.13 | 26.35 |
| Total soluble solid (%) | 4.98±0.05 | 3.47-4.58 | 3.68-5.96 | 12.63 | 11.6 | 84.37 | 1.4 | 28.12 |
| Ascorbic acid content (mg/100g) | 30.06±11.08 | 20.63-33.46 | 23.80-35.82 | 16.11 | 11.85 | 54.03 | 6.92 | 22.99 |
| Titrable acidity (%) | 0.79±0.002 | 0.47-0.91 | 0.65-1.03 | 15.28 | 14.21 | 86.46 | 0.28 | 34.89 |
| Number of fruits/plant | 36.89±5.20 | 24.79-60.17 | 26.76-65.44 | 29.17 | 28.51 | 95.5 | 26.94 | 73.54 |
| Average weight of fruit (g) | 50.26±5.10 | 27.25-60.22 | 41.13-60.01 | 13.73 | 12.95 | 89 | 16.21 | 32.26 |
| Early yield per plant (kg) | 0.53±0.003 | 0.28-0.66 | 0.35-1.42 | 42.02 | 40.87 | 94.58 | 0.56 | 104.93 |
| Total yield per plant (kg) | 1.57±0.02 | 0.87-1.46 | 1.04-3.06 | 31.35 | 30.19 | 92.72 | 1.19 | 76.75 |

PCV = Phenotypic co-efficient of variation, GCV= Genotypic co-efficient of variation, $h^2$ (bs) = Heritability in broad sense, GA = Genetic advance, GG= Genetic advance in per cent of mean *i.e.* genetic gain

## Conclusion :

The present investigation concluded that genetic variability is a prerequisite to start within any crop improvement programme. The results revealed presence of wide exploitable variability and heritability in the material examined with respect to various morphological traits indicating thereby, immense scope of genetic up gradation in tomato. High heritability coupled with high genetic advance was noted for plant height and number of fruits/plant, early yield/plant and total yield/plant which may be due to additive gene action and hence, for these traits simple selection will be rewarding. While for other traits hybridization followed by selecting desirable transgressive segregants will be better options.

## REFERENCES

**Ajmal, S.U., Zakir, N. and Mujahid, M.Y. (2009).** Estimation of genetic parameters and character association in wheat. *J. Agric. & Biol. Sci.,* **1**(1) :1 5 - 18.

**Ali, Y., Att, B.M., Akhter, J., Monneveux, P. and Lateef, Z. (2008).** Genetic variability, association and diversity studies in wheat (*Triticum aestivum* L.) germplasm. *Pakistan J. Bot.,* **40** (5) : 2087-2097.

**Burton, G.W. (1952).** Quantitative inheritance in grasses. *Proceeding 6th International Grassland Congress,* **1**: 227-283.

**Burton, G.W. and De, Vane (1953).** Estimating heritability in tall Fescue from replicated clonal material. *Agron. J.,* **45**: 474-481.

**Chandrasekhar, P. and Rao, M.R. (1989).** Studies on combing ability of certain characters in tomato. *South-Indian-Hort.,* **37**: (1): 10-12.

**Dhaliwal, M.S., Singh, S. and Cheema, D.S. (2000).** Estimating combining ability effects of the genetic male sterile lines of tomato for their use in hybrid breeding. *J. Gen. & Breed.,* **54** (3) : 41-44.

**Dudley, J.W. and Moll, R. H. (1969).** Interpretation and uses of estimates of heritability and genetic variance in plant breeding. *Crop Sci.,* **9** : 257-262.

**Falconer, D.S. (1960).** *Introduction to quantitative genetics*. Oliver & Boyd, Edinburgh/LONDON, UNITED KINGDOM.

**Gulnaz, S., Sajjad, M., Khaliq, I., Khan, A.S. and Khan, S.H. (2011).** Relationship among coleoptiles length, plant height and tillering capacity for developing improved wheat varieties. *Internat. J. Agric. & Biol.,* **13** (1):130-133.

**Hanson, W.D., Robinson, H.F. and Comstock, R.E. (1956).** Biometrical studies of yield in segregating population of Korean Lespedeza. *Agron. J.,* **48**: 268-272.

**Johnson, R.E., Robinson, H.W. and Comstock, H.F. (1955).** Estimates of genetic and environmental variability in soybeans. *Agron. J.,* **47**: 314-318.

**Kalloo, G., Banerjee, M.K., Tewari, R.N. and Pachoure, D.C. (2001).**Vegetables, tuber crops and spices.1st Ed. Directorate of info. and Publ.of Agric., I.C.A.R.New Delhi, India, pp.10-25.

**Kempthorne, O. (1957).** *An introduction to genetic statistics*. John Wiley and Sons, Inc, New York, U.S.A., pp.468-471.

**Kumar, T.P., Tewari, R.N. and Pachauri, D.C. (1997).** Line×tester analysis for processing character in tomato.*Veg. Sci.,* **24**(1):34-38.

**Lush J.L. (1949).** Heritability of quantitative traits in farm Animals. Proc 8th Inst Cong Genetic, *Herides*, 336-357.

**Panse V.G. (1958).** Genetics of quantitative characters in relation to plant breeding. *Indian J. Genet.,* **17** : 318-328.

**Srivastava, J.P., Singh, Hamveer, Srivastava, B.P., Verma, H.P.S. and Singh, H. (1998).** Heterosis in relation to combining ability in tomato. *Veg. Sci.,* **25**(I):43-47.